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ABSTRACT

This paper reports on a study on the perceived effectiveness of educational resources within the context of a single course in a first-year biology program at the University of Sydney (Australia). The overall study examined the dynamic state of perceptions towards these resources by the major stakeholders involved with the course (students, teaching staff, and technical staff). A major focus of the research was the extent to which the students used the computer-based resources made available to them, and staff and students' perceptions of the usefulness of these resources in supporting their learning. Specifically, results are discussed related to student use of computers and the Internet, use of biology online materials in the virtual learning environment, use and perceptions of communication technologies, and use and perceptions of computer-based online resources. Data were collected from the students using surveys and focus groups and from staff using surveys and interviews within an action-research paradigm. While the majority of students found the resources to be of use in supporting learning, some did not find them useful, and some did not use them at all. In comparison, the staff had higher expectations of both usage and usefulness. The level of student use was not a function of access to computers or the Internet, so the findings suggest that the provision of online resources will not necessarily generate value-added learning. (Contains 19 references.) (Author/MES)

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# STAFF AND STUDENT VIEWS OF THE USEFULNESS OF INFORMATION TECHNOLOGY MATERIALS WITHIN AN INTEGRATED CURRICULUM: ARE THESE EDUCATIONAL RESOURCES EFFECTIVE IN PROMOTING STUDENT LEARNING?

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**Abstract**

*This paper reports on specific outcomes of a study on the perceived effectiveness of educational resources within the context of a single course in a first-year biology program. The overall study examined the dynamic state of perceptions towards all of these resources by the major stakeholders involved with the course (students, teaching staff and technical staff). A major focus of the research, reported here, was the extent to which the students used the computer-based resources made available to them, and staff and students' perceptions of the usefulness of these resources in supporting their learning.*

*Data were collected from the students using surveys and focus groups and from staff using surveys and interviews, within an action-research paradigm. While the majority of students found the resources to be of use in supporting learning, it is of interest that some did not find them useful and some did not use them at all. In comparison the staff had higher expectations of both usage and usefulness. The level of student use was not a function of access to computers or the Internet, so the findings suggest that the provision of online resources will not necessarily generate value-added learning.*

**Keywords**

*perceptions of IT use, student learning, biology education, online learning evaluation*

## Introduction

First year science courses at The University of Sydney have high enrolments, with students in many different degree programs in Science, Agriculture, Education, Arts and Engineering. This large group of students is very heterogeneous, characterised by varied educational and academic backgrounds with a broad range of incoming entry grades, and a range of incoming generic skills (writing, computer, team-work, etc.). Many of these students (not enrolled in specialist Science degrees) have a wide choice of subjects, which often means they are unsure of their future directions. In addition many students arrive at university with an expectation of being spoon-fed (McInnis, James, & McNaught, 1995), having been conditioned to using a surface approach to

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learning in high school, whereas at university they need to focus more on deep learning strategies to succeed within their chosen degree programs. It is recognised that active involvement in the learning scenario can lead to the use of deep learning strategies (Sutcliffe, Cogdell, Hansell & McAteer, 1999). Computer-based activities offer learning experiences that are under the control of the individual learner, that may better suit individual needs and offer active involvement by way of interactivity. Increasingly the Web is being used to create a better learning environment that is more independent of teacher interaction, is sustainable in the current economic climate and encourages the development of lifelong learning strategies. To provide this type of learning environment, the School of Biological Sciences at The University of Sydney set up a virtual learning environment (online), allowing students to access resources anywhere/ anytime. The development of this resource, and preliminary evaluations of its use by students, are discussed elsewhere (Peat, 2000a).

Within this Virtual Learning Environment (VLE) there are both communication and learning resources. The communication resources include both email access to staff and discussion fora, whilst the learning resources include online lecture notes, learning modules, self-assessment modules and links to useful websites.

There are three main types of learning module: interactive explorations, how to use equipment and generic skills development. The interactive explorations of biological topics are designed to be used in conjunction with paper-based materials, which contain a large amount of information at a variety of depths for students to explore in order to complete project and laboratory exercises. They enable biological processes to be illustrated in an animated manner that would otherwise not be available. Introductions to the use of specific equipment are designed to be completed before attending a laboratory class. The advantage of these modules is that after learning about the equipment, the student can "use" it to practice, before attending the class. Generic skills development modules train students in skills such as writing scientific reports. All the learning modules have quiz questions interspersed within the content and a section at the end so that students can further test themselves. Self-assessment online materials include specially designed Self-Assessment Modules (SAMs), self-test quizzes associated with each week's laboratory class and practice exams. SAMs enable students to self-assess their understanding of content and concepts, and incorporate four levels of difficulty each of increasing cognitive complexity and are additional optional materials (Peat, Franklin & Lewis, 2001). Many of the online resources are integrated within the curriculum and are required as pre-work to laboratory classes, learning materials within laboratory classes and as homework after a laboratory class. Other optional material is available is itemised for the students in their paper-based notes.

The current study examined one of the first year courses, Human Biology, which integrates a range of computer-based learning modules, online materials and communications strategies with more traditional learning resources such as lectures and practical sessions. It is recognised that the incorporation of information technology can change the roles of students and teachers, facilitate more student-centred learning and expand the scope and content of the curriculum (Horgan, 1998). Given the current environment, the learning paradigm is one where students are provided with a range of resources to cover the curriculum of the course and this range has been designed to cater for a variety of learning styles.

The purpose of this study was to provide both a reflective and analytical assessment of a broad range of learning resources integrated through web-based technology. An action research model was designed to collect data to enable assessment of the learning environment from all stakeholders. This approach was taken for three reasons. Firstly, the students constitute an heterogenous group with a large set of opinions regarding educational multimedia and communications technologies. Secondly, the educational multimedia resources used within this course have already been demonstrated as effective (Peat, 1999; 2000b; Peat, Franklin & Mackay-Wood, 1997). They have been developed over a number of years and formative evaluation has enabled enhancement of each resource as it was being integrated into the curriculum. In particular during this process, formative monitoring of the learning environment assessed (and improved) the functionality of the resources.

For this investigation it was considered more important to focus on the overall teaching and learning process rather than the effectiveness of individual resources. Thirdly, the research agenda within instructional technology has gone beyond that of comparing resources to one of making them work better (Reeves, 1999). Early meta analyses (e.g. Kulik & Kulik, 1986, 1991) reported significant gains for learners using computers compared with traditional learning resources. However, recent commentary questions whether this early research reflects any real gain (e.g. Stoll, 1996). For this project the focus was not on the individual resources as effective learning tools, but on the perceptions of both students and teaching staff as to their importance in the overall teaching and learning process; this is particularly significant with the increased emphasis by tertiary institutions on online learning and given the amount of time and money that had been spent on the development of all the teaching and learning resources. This paper examines the role of educational multimedia and communications technologies on the learning opportunities for a large group of first year students from the student and staff perspectives. The outcomes of the overall study will inform other curriculum developments within first year biology courses.

## The Stakeholders

The stakeholders included students (n=up to 800), lecturers (n=5), laboratory teaching staff (n=20), technical staff (n=3), and courseware developers (n=2). The target population of students is typically recent high school leavers enrolled in science-based degree programs. The lecturers are responsible for their own lectures although they must follow a course outline and they may not all be involved in the laboratory teaching. The laboratory teaching staff form a diverse group, many of whom are casual, staff employed just for the laboratory sessions. Anecdotal evidence suggests that this group of staff (and maybe also the technical staff) have pre-conceived ideas about the aims and outcomes of the course (in spite of written information detailing these issues) and they may not necessarily appreciate how the different learning resources can be used by students. The teaching staff were asked to keep encouraging students to use the online resources as the semester proceeded. Such encouragement was included in the weekly announcements for each laboratory class and emphasised by the class supervisor. Examining the alignment/ non-alignment of staff-student perceptions of the resources will allow any serious misalignment discrepancies to be addressed.

## Methodology

The research model used was based on the more recent arguments of Reeves (1993) and Alexander and Hedberg (1994) which have led to a model involving a mixed approach to data production and analysis, with both quantitative and qualitative information obtained in the evaluation process. Described as the Eclectic-Mixed Methods-Pragmatic Paradigm (Phillips, Bain, McNaught, Rice & Tripp, 2000), this approach is considered more capable of handling the complexity of modern society and technology, with a focus on practical problems rather than on issues, whilst also acknowledging the weakness of current evaluation tools.

The overall study was based on the perceptions of the major stakeholders involved in the course; however, **this paper focuses on the laboratory teaching staff and students' perceptions** of the use of educational multimedia and communications technologies within an integrated curriculum. The overall data collections involved all stakeholders and data were collected at four separate intervals, using surveys, interviews and/or focus groups. Figure 1 represents the action research model used in this project and Table 1 identifies from which stakeholder group data was collected at each point. Student surveys were conducted at each of the data collection points ($DC_1$-$DC_4$). At $S_1$ all students were surveyed, during the fourteen laboratory sessions of the first week of the semester. Subsequent data collection by survey was of a subset of this stakeholder group with $S_2$, $S_3$ and $S_4$ each surveying half the total number of students but chosen at random. Laboratory teaching staff were surveyed, lecturers were interviewed, as were the technical staff and the courseware developers. Both qualitative and quantitative data were collected.

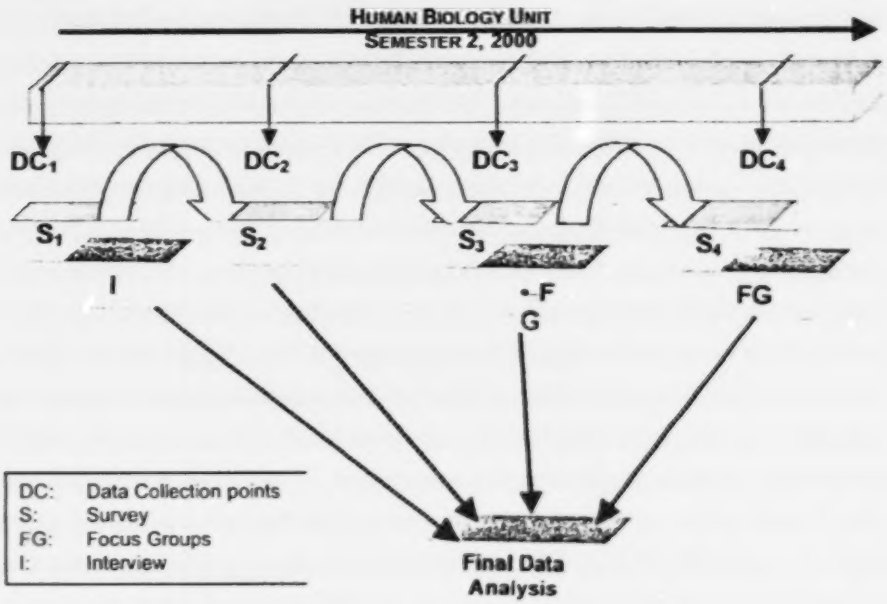


*Figure 1. Project strategy*

| | Data Collection Points | | | |
|---|---|---|---|---|
| **Stakeholders** | **DC1** | **DC2** | **DC3** | **DC4** |
| ***Students'*** | ***S*** | ***S, FG*** | ***S*** | ***S, FG*** |
| ***Laboratory teaching staff*** | ***S*** | - | - | ***S*** |
| Lecturers | I | - | - | - |
| Technical staff | I | - | - | - |
| Courseware developers | I | - | - | - |

*Table 1. Identification of data collection methods and stakeholders*

The first data collection point ($DC_1$) was at the commencement of the course. This established a benchmark of both student understanding and perceptions prior to any teaching and learning influences and the other stakeholders' perceptions of the students. A separate instrument was designed for each of the stakeholder groups such that the questions focused on similar course delivery issues and all stakeholder perceptions of learning resources and how they would be used. This enabled the alignment of responses and the derivation of common themes in terms of the understanding, potential and use of learning resources within the course. It asked all stakeholders for their expectations of the use of different learning resources (including educational multimedia).

Whilst the data from each data collection point were used to inform the next survey or focus group and this has been described elsewhere (Franklin, Peat & Lewis, 2001), the comparison of staff and student perceptions relates to the data collected at $DC_1$ and $DC_4$. In addition, the demographic information provided from the first survey ($S_1$) has also been discussed in detail elsewhere (Peat *et al.*, 2001). The main information to note here is that 99.5% of students have access to a computer, with 98.5% of all students indicating access to the Internet (84% access at home). An interesting issue is that there is now significant competition within the home for the Internet line (36.5% of students indicating competition from siblings or parents).

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## Results and Discussion

This section reports on the major factors emerging from this research process including:

- student use of computers and the Internet;
- student use of online materials in the Virtual Learning Environment;
- student views of communications technologies;
- students' perceptions about using online materials (tutorials, revision modules, self-assessment modules); and
- staff perceptions of the use students make of online resources and how they (the staff) rate the usefulness of these materials for student use.

### *Student Use of Computers and the Internet*

The demographic analysis from $S_1$ indicates that students have good access to the Internet (98.5%); however, it was important to know whether the students used the Internet for their learning in Human Biology and if they perceived these resources useful to their learning, in order to justify the provision of these web-based first year biology resources. Similarly it was important to know what the staff perceptions were about students using the Internet to support learning. At the commencement of the semester, 54% of students expected it to be necessary to use a computer weekly, and 33% expected a daily need in order to participate in, and successfully complete, the Human Biology course (see Table 2). During the course 71% of students used a computer weekly for Human Biology and 13% accessed one daily (i.e. 84% used a computer at least weekly). The results were similar for Internet use as also shown in Table 2. Weekly use of a computer for human biology-related activities appeared to be sufficient. On the other hand the laboratory teaching staff thought that every student would use a computer and the Internet to support their learning (Table 2) and, in agreement with the students, that weekly use would be sufficient. This highlights that, as teaching staff, we automatically assume all students are using computers for course-related matters.

| | | Staff | | Students | |
|---|---|---|---|---|---|
| | | $S_1$ | $S_4$ | Expectation ($S_1$) | Actual ($S_4$) |
| **Use of computer** | never/rarely | 0% | 0% | 13% | 16% |
| | weekly | 74% | 91% | 54% | 71% |
| | daily | 26% | 9% | 33% | 13% |
| **Use of Internet** | never/rarely | 0% | 9% | 11% | 20% |
| | weekly | 90% | 73% | 55% | 64% |
| | daily | 10% | 18% | 34% | 16% |

*Table 2: Use of computers and the Internet to support learning*

The fact that 16% of students never or rarely use a computer and 20% never or rarely use the Internet to support their learning in Human Biology is of great concern, as we provide a significant amount of computer-based learning resources, mostly accessed on the Internet.

### *Use of Biology Online Materials in the Virtual Learning Environment*

The biology web-based resources, accessed via a Virtual Learning Environment (online), offer online lecture notes, educational multimedia materials and communications technologies; students are encouraged to use it as the principal website for the course. Thus it would be expected that there would be no difference between students' expectations of their use of the VLE to support their learning and their actual use, and this was found to be the case (Table 3), with 85% of students using the VLE. A few students (15%) did not actually use the VLE at all during the course, which corresponds to the 16% of students who, at the end of the semester, responded that they rarely or never accessed a computer to support their learning in Human Biology (Table 2). Students' perceptions of the usefulness of the VLE did not change over the semester, with 94% of students who used the resource perceiving it would be useful/ extremely useful and reporting it to

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be so (Table 4). This may be due to their experience of the VLE during the previous semester's course. However, the staff believe all students would have been using the VLE during the course, in particular to access the online lecture notes (just as they believe all students would use a computer at least weekly) when in fact the actual use of the VLE is less (85%). Again staff overestimated the usage of the VLE by the students to support their learning.

| | Staff | | Students | |
|---|---|---|---|---|
| | $S_1$ | $S_4$ | Expectation ($S_1$) | Actual ($S_4$) |
| **Use of VLE to support learning** | 90% | 100% | 85% | 85% |
| **Usefulness (to those who used it) of VLE in supporting learning** | | | | |
| Not useful | 0% | 0% | 6% | 6% |
| Useful | 61% | 27% | 47% | 44% |
| Extremely useful | 39% | 73% | 47% | 50% |

*Table 3: Use of and perceptions of the usefulness of the biology virtual learning environment*

Whilst general access to computers and the Internet is good, there is some concern within the student body about access to the educational multimedia materials made available via the VLE on the Internet for this course. A number of students (16%) indicated they had difficulties in accessing these materials and open-ended question methodology was used to find out why. In response to the question "Do you have any difficulties accessing First Year Biology Internet resources? If, yes, please indicate why?" there were 50 responses and these were categorised within themes. The major difficulties identified were difficulties with software (28% of all responses), insufficient RAM (22%) and download times (18%). The most frequently stated comment was about the difficulties with the "plugins" needed to view the educational multimedia modules online. The remaining 32% of responses covered competition for access, navigation and hardware problems.

We can provide the technology but we need to be careful that we match this with student abilities and experiences. Some universities provide all students with electronic toolkits to help them in using the Internet but this is only of use if the students are able to access the toolkit materials and use them. We are considering providing the students with our educational multimedia materials, with the appropriate plugins, on a CD.

### *Use and Perceptions of Communication Technologies*

The facility for both chat groups and email were provided to students via the VLE. Web-based chat groups were initially not considered by many students to be a resource that they would use to support learning (16%) and in actual fact even fewer (5%) used chat groups during the semester to support their learning in Human Biology.

Email as a form of asynchronous communication, was considered to be a more useful resource to support learning in Human Biology. The student expectation of their probable use of email and its potential usefulness was, however, greater than the reality. At the commencement of the course 59% of students expected to have access to email at least weekly in order to participate in and successfully complete the course, whereas only 29% actually used email weekly (Table 4). In contrast the staff at the end of the course assumed that a much higher percentage of students (64%) would have used email at least weekly. Interestingly, 22% (about 160 students) initially expected to be in daily email contact but only 5% (40 students) actually used email daily, with the majority of students only using email weekly. Similarly 41% of students expected email to support their learning in Human Biology but in reality only 22% used it for this purpose. Of those 22% of students who used email, 57% found it useful/ extremely useful in supporting their learning. This means that approximately 10% of the entire cohort found email useful in supporting student learning (only 80 students).



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The fact that 71% of the entire cohort are never or rarely accessing email for course-related matters is of concern as we are currently sending email messages to all students via an electronic list, often on a weekly basis. These students are potentially missing out on important course information. However, whilst Table 4 reports on expectations of use (from $S_1$) and actual use (from $S_4$) of email to support learning in the Human Biology course, a mid-course survey ($S_2$) indicated that the overall student use of email was high, with 97% of all students surveyed indicating some use. Most of this use (75%) was for other than course-related activities. It should be noted that all students have been provided with a free email address by the University.

| | | Staff | | Students | |
|---|---|---|---|---|---|
| | | $S_1$ | $S_4$ | Expectation ($S_1$) | Actual ($S_4$) |
| **Use of email** | Never/rarely | 16% | 36% | 41% | 71% |
| | Weekly | 48% | 55% | 37% | 24% |
| | Daily | 36% | 9% | 22% | 5% |
| **Usefulness (to those who used it) of Email in supporting learning** | | | | | |
| | Not useful | 22% | 9% | 41% | 43% |
| | Useful | 61% | 82% | 48% | 47% |
| | Extremely useful | 17% | 9% | 11% | 10% |
| **Use of Chat groups to support learning** | | 42% | - | 16% | 5% |

*Table 4: Use of and perceptions of the usefulness of communication technologies in support of their learning*

The student expectation for using email was much higher than the reality of using it and this needs to be viewed in the light of the other stakeholders' perceptions. The laboratory teaching staff expected a higher actual usage of email, and that email would be more useful in supporting student learning than students actually reported. Interestingly the initial high expectation of staff for email use by students (84%) had declined to 64% by the end of the semester, but was still much greater than the actual use of email (29%) by students. It may be that as teachers we have unrealistic expectations and that there is a mismatch between what we think as providers and how the students perceive the resources provided. It may be that the students, whilst expecting to use the technology, find they do not like using it or do not know how to use it and that these issues have not been addressed.

Student use of email was further investigated within focus group discussions where students indicated that they appreciated and expected information to be sent to them via email but that they would rather talk face-to-face with staff as this gives immediate feedback and allows for follow-up questions. Students found email responses to be "not fast enough", expecting immediate responses to their questions.

### *Use and Perceptions of Computer-based Online Resources*

Since 1992 computer-based learning modules have been introduced into all the first year biology courses. In the human biology course there are many online materials available for the students to use: tutorials designed to be resources for students to use in conjunction with paper-based materials; pre-lab modules or introductions to the use of laboratory equipment; revision modules to review materials; and self-assessment modules allowing students to take a series of formative tests and exercises aimed at helping them monitor their level of understanding of major biological concepts.

Focusing on the online tutorials, at the start of the course students' expectation of the use of these resources was high (73%) (Table 5), matching their expectation of Internet use. Whilst a survey ($S_2$) during the course indicated their use to be relatively low (Franklin *et al.*, 2001), by the end of the course, computer-based tutorials had been used by 75% of the students (Table 6). There was no difference in the students' expectations of the use of computer-based tutorials and their actual final

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use to support their learning, although, again, the laboratory teaching staff expectations were higher than the students believing 91% of students would have been using them. There was a match of students' initial expectations (91%) of the usefulness of the computer-based tutorials with actual usefulness (91%). However, it is important to note that 25% of students did not use the computer-based tutorials to support their learning, and we need to investigate the reasons why. These results mirror the recent work of Oliver and Omari (2001) who found that 20% of students were not comfortable with using the Web as their learning environment and suggested that this number of students (50 in their cohort) is too big to be ignored when making decisions on delivery of materials.

The current study's data indicate that there are 200 students not using the educational multimedia materials. Given that 91% of those students that did use the materials found them useful, it is important to explore why this group of non-users do not avail themselves of these learning resources. They may be computer-phobic (although our anecdotal and survey data suggests that all students can use a computer) or it may be that this is not a good learning experience for them.

| | Staff | | Students | |
|---|---|---|---|---|
| | $S_1$ | $S_4$ | Expectation ($S_1$) | Actual ($S_4$) |
| **Use of CBT to support learning** | 90% | 100% | 85% | 85% |
| **Usefulness (to those who used it) of CBT in supporting learning** | | | | |
| Not useful | 0% | 0% | 9% | 9% |
| Useful | 66% | 45% | 60% | 53% |
| Extremely useful | 34% | 55% | 31% | 38% |

*Table 5: Use of and perceptions of the usefulness of computer-based online tutorials (CBT)*

Whilst in this current study we did not ask why students were not using online resources to support their learning, a smaller investigation targeting the use of one of the online resources, the self-assessment modules (SAMs), revealed the following reasons for non-use: lack of time (29% of all responses), not knowing they were available (27% of all responses), access problems (23% of all responses) and not motivated to use them (17% of all responses). The main reasons appear to be lack of time and lack of knowing the SAMs were available. This may also apply to the online resources in general.

## Educational Implications

The message coming out of this study is that there are students who embrace educational multimedia and information and communications technologies and who will find these learning experiences valuable. However, there is fraction of the cohort (15-20% of 800 in the current study) that, for whatever reason, are not taking up the challenge of these new(er) technologies. Maybe there is a mismatch between us as providers of the resources and students as users of these resources. Questions yet to be explored include: "Did the students not like the resources?", "Were the resources hard to use?", "Are the resources perceived as core or additional?" and "What additional help is required to enable students to use the proffered materials?"

The staff who teach in these large first year courses need to be more informed of the characteristics of the student cohort. In all instances the staff expectations of students use of educational multimedia and information and communications technologies were higher than the students' expectations, highlighting a degree of misalignment between the two. Interestingly staff perceptions of the usage by students of the biology virtual learning environment and computer-based online tutorials increased as the course progressed, even though staff initial expectation was much higher than student actual usage (Tables 3 and 5). Staff need to understand that not all

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students will embrace the technologies offered and that if we require all our students to be using these technologies then we must be more sensitive towards those who appear to need more support.

It is important to evaluate the computer-based / Internet-based materials in the context of the curriculum and to remember that the student body requires a variety of learning experiences that not only embrace the electronic world but are also anchored in the more traditional offerings.

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